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The Effect of Semantic Constraint on Lexical Access in Bilingual Word Recognition

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Abstract

The current study investigated how a constraining sentence context affects processing times in second language (L2) word identification. We used eye-tracking to look at whether the *cognate facilitation effect*, a cue of non-selectiveness in bilingual lexical access, is affected by the presence of a strong semantical sentence context. Norwegian-English bilinguals read sentences containing cognates or matched controls in sentences providing either a high constraining or a low constraining context. We found cognate facilitation effects for high constraining sentences for gaze durations, but none of the other eye-tracking measures. This supports a theory of bilingual non-selective lexical access, which can vary in degree based on different factors. We discuss our results in context of the BIA+ model (Dijkstra & van Heuven, 2002).

Keywords: cognates, bilingual word processing, lexical access, semantical context

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1 Introduction

How the mental lexicon is organised is a question at the forefront in psycholinguistic research. Lexical access of individuals is a key issue to investigate the nature and organisation of the mental lexicon. There are several models of visual word recognition, and their common assumption is that there are several lexical representations stored in memory that the input string is mapped to (McClelland & Rumelhart, 1981; Paap, Newsome, McDonald, & Schvaneveldt, 1982). We know from previous studies that competing words in the lexicon are activated in a parallel manner. The parallel activation can be due to multiple reasons, such as ambiguity in word meaning (semantic level) (Onifer & Swinney, 1981; Swinney, 1979) or similarities in word form (phonological or orthographic level) (Andrews, 1989). The general assumption is that in the mental lexicon, the activation can be inhibited or facilitated between different levels (e.g. semantical feature level to word level) and inhibited within the levels (e.g. competition between lexical candidates on the word level) before it ultimately settles for the correct word (McClelland & Rumelhart, 1981). There are several factors affecting the process of lexical selection. One of these is the frequency of a word, where more frequent words are more easily accessed and selected than less frequent words (Rayner & Duffy, 1986). Another factor is the semantical context of a sentence, which can affect lexical access by facilitating the activation of a certain word or meaning. As an example, Duffy, Morris, and Rayner (1988) found that context can bias the less frequent meaning of an ambiguous word, leading to difficulties in lexical access. This demonstrates that the process of lexical access is not only a process revolving a single word.

The studies cited in above all investigate lexical access in monolinguals. An interesting question regarding the mental lexicon and lexical access is how these processes take place in bilinguals. Two crucial issues in the literature have been whether the processes of lexical access and the organisation of the mental lexicon are (1) the same in bilinguals and monolinguals, and (2) the same between and within languages. A question that has been particularly important to address these issues, is whether lexical access in bilinguals is selective or not, i.e. whether the bilingual lexicon involves activation of lexical representations from both or only one language (Dijkstra & van Heuven, 2002). As an example, if a Norwegian-English bilingual reads the word 'lager' in an English text (Eng.: *type of beer*, Norw.: *storage room*), selective access would mean that only the English meaning is accessed. In contrast, if bilingual lexical access is non-selective, both meanings of the word would be accessed, at least for a short period. Compared to the findings discussed in the previous paragraph about monolingual lexical access,

a key question about lexical access in bilinguals is therefore: Does the parallel activation between competing words extend across the two (or more) languages in bilingual lexical access, or is it limited to only within each language?

In our study, we investigate the nature of lexical access in bilinguals by combining the two lines of research discussed in the two paragraphs above. We do this by looking at how bilinguals process cognates, i.e. words that are related in both form and meaning across two languages, in sentence contexts. An example of a cognate word is *hammer*, which has the same orthography and meaning in both Norwegian and English. We will contrast sentence contexts by looking at the processing of cognates and controls in high constraining sentences (a sentence where the target word appearing is highly likely) versus low constraining sentences (where the likelihood of the target word appearing is close to zero). This yields an interesting perspective on lexical access because we can look at the effect of sentence constraint and bilingualism at the same time.

Below, we will introduce relevant research on the effect of sentence constraint and cognate status on lexical access. In the second section, we describe our experiment and its results. In the general discussion, we discuss these results, and compare them to earlier findings before we discuss what implications our findings have for the BIA+ model (Dijkstra & van Heuven, 2002), which is a model on bilingual language processing.

1.1 Background

1.1.1 Sentence constraint in monolingual lexical processing

We know from earlier studies in the monolingual domain that sentence constraint affects visual word recognition. A high constraining sentence has been found to facilitate lexical decision times for words that are expected to appear in the sentence compared to highly related, unexpected words in the same constraint (Schwanenflugel & Shoben, 1985). Interpreted in light of the Interactive Activation Model (McClelland & Rumelhart, 1981), the assumption of Schwanenflugel and Shoben (1985) is that more nodes are activated at the semantic level for sentences with high constraint, which leads to facilitation in the activation levels of their compatible word nodes, and inhibition for word nodes (even for related words) that are incompatible. In low constraint sentences, only a few nodes are activated on the semantic feature level, leading to facilitation of a greater number of lexical candidates on the word level compared to the high constraint situation, and additionally, the number of inhibited, incompatible lexical items would be smaller (Schwanenflugel & Shoben, 1985). Context can also influence parallel activation: ambiguous words were fixated on longer than controls when

the preceding context biased its subordinate meaning (Kambe, Rayner, & Duffy, 2001). Crucially relevant for our study are findings showing that eye movements in reading are affected by sentence constraint. Target words are fixated on more often and for longer in low constraining sentences than in highly constrained targets and targets in high constraining sentence are skipped more often than words in low-constraint sentences. (Ehrlich & Rayner, 1981; Rayner, 1998; Rayner & Well, 1996).

1.1.2 Selectivity in bilingual lexical processing

A significant part of the research addressing the question of selectiveness in lexical access has focused on the processing of cognates. An important finding from these studies is that the processing of cognates is facilitated compared to control words that do not share form or meaning across languages. The *cognate facilitation effect* has received support from several studies looking across different languages, showing that cognates are processed faster than controls when presented in L2. This holds for different experimental designs and language processing tasks, such as lexical decision tasks (Dijkstra, Grainger, & van Heuven, 1999; Dijkstra, van Hell, & Brenders, 2015; Duyck, van Assche, Drieghe, & Hartsuiker, 2007; Lemhöfer & Dijkstra, 2004; van Hell & de Groot, 2008), priming (de Groot & Nas, 1991) and reading (Duyck et al., 2007; van Assche, Drieghe, Duyck, Welvaert, & Hartsuiker, 2011; van Assche, Duyck, Hartsuiker, & Diependaele, 2009), as well as language production tasks, as for instance in picture naming tasks (Costa, Caramazza, & Sebastian-Galles, 2000; Schwartz, Kroll, & Diaz, 2007; Starreveld, de Groot, Rossmark, & van Hell, 2014). The cognate facilitation effect yields support for a non-selective, parallel activation of lexical access in bilinguals, meaning that lexical access does not take place in each language separately, but that one can have lexical competition between two languages simultaneously. The assumption is that spreading activation between lexical items across two languages leads to the faster processing times for cognates, as these items are thought to involve shared mental representations between the languages.

Different factors affect the cognate facilitation effect. Although the effect has been found also in tasks performed in L1 (van Assche et al., 2009; van Hell & Dijkstra, 2002), the language of the task may affect the strength and even the presence of an effect. In this study, we focus on cognate processing in L2. A second modulating effect is proficiency. In a RSVP naming task, Schwartz and Kroll (2006) found that more proficient readers had a smaller effect of the cognate facilitation effect.

The studies from the monolingual domain indicate that word processing is facilitated if a target appears in a high constraining context. The studies on cognate processing have shown that cognates are processed faster than their matched controls. How do these two modulating factors, sentence constraint and cognate status, affect word processing and lexical access together? Recent research on cognates has focused on how they are processed in a sentence context and studies where the cognate appears in low-constraint sentences have shown that the cognate advantage persists in a low constraining sentence (Dijkstra et al., 2015; Libben & Titone, 2009; Schwartz & Kroll, 2006; van Assche et al., 2011; van Assche et al., 2009; van Hell & de Groot, 2008). For instance, Duyck et al. (2007) found in an eye-tracking study of Dutch-English bilinguals, that the processing of identical cognates, such as *bar*, is faster in a low constraining context than non-identical cognates, such as *apple* – *appel*, which did not differ from controls.

The results regarding cognate effects in high constraining sentence, on the other hand, have been less consistent: some studies found an inhibition or a complete elimination of the cognate effect in high constraint sentences (Schwartz & Kroll, 2006; van Hell & de Groot, 2008). Schwartz and Kroll (2006) examined L2 word recognition (Spanish-English bilinguals) on cognates with an RSVP paradigm, and found facilitation for cognates in low constraining sentences, but not in high-constraint sentences. In other studies, the cognate advantage was not affected, despite of the cognates appearing in a high constraining sentence (Dijkstra et al., 2015; van Assche et al., 2011). For instance, a study from Dijkstra et al. (2015), showed that Dutch-English bilinguals show cognate-facilitation in a lexical decision task when the target was preceded by an L2 semantical context, regardless of the sentence being high or low constraining.

The studies discussed in the previous paragraph suggest that the presence of a high constraining sentence context may partially or completely override the facilitatory effect of cognates. However, the results from the different studies are not convergent, making it difficult to draw any conclusions about real effect of sentence constraint. In a recent quantitative meta-analysis on the results of studies examining cognates within high or low sentence constraints, it was found that the weighted effect size of cognate facilitation was significant for both high constraint and low constraint sentences, but that the weighted average effect was significantly smaller for high constraining sentences (Lauro & Schwartz, 2017). Lauro and Schwartz (2017) point out two variables that may account for the differing outcomes of the studies they analysed: (1) task type, with largest effect sizes for tasks requiring overt responses (e.g. LDT), and smallest effect sizes for non-overt response tasks such as reading, and (2) the language of the

task: studies in L2 yielded significant effect sizes for cognate facilitation in both high and low constraints, whereas L1 studies only found an effect for cognates in low constraint sentences. The authors suggest that the nature of selectivity in bilingualism is not either/or, but rather a dynamic process which fluctuates over time depending on different processing stages (from word identification to word meaning integration).

Based on these findings, we examine the hypothesis of gradient selection in bilingual lexical access. Our study will use eye-tracking in reading to examine the cognate facilitation effect in L2 because it enables us to look closer at the time course of word processing, and thus we can investigate whether there are any differences between initial and later stages of lexical access. We found evidence of cognate facilitation in the high constraints only for one eye-tracking measure, which we interpret as further support for dynamic selectivity in bilingual lexical access.

In the next section, we present the experimental design of our experiment, along with the results.

2 The present study

The primary aim of the current study is to further investigate the cognate effect along with the role of sentence constraint in lexical access of bilinguals in reading. The study has a 2×2 design matrix, where Norwegian-English successive bilingual participants read Norwegian-English cognate words and non-cognate controls embedded in high- or low-constraint sentences. The participants read the sentences in their L2 language (English) and the cognates were orthographically identical to the corresponding words in their L1 language (Norwegian). In the analysis, we examine the effect of word type, sentence constraint and word frequency on early and late eye tracking measures. Following the earlier findings regarding the cognate facilitation mentioned above, we expect to find shorter reading and processing times for cognate words compared to their matched controls. Furthermore, we expect sentence constraint to modulate the cognate facilitation effect. There are three possible outcomes for the results in our study: compared to a low constraining sentence, a high-constraining sentence would (1) eliminate any cognate facilitation effect, or (2) reduce cognate facilitation, or (3) not affect a cognate facilitation. In addition, we predict that the early and late measures might differ from each other by showing cognate effects in the early measures and no effects of cognates in the late measures. In order to make our results more comparable to earlier findings, the experimental design and data analysis is partly based on the study of van Assche et al. (2011).

The significance of the current study for the existing literature is twofold: firstly, it will add validity to previous studies on the cognate effect and the effect of sentence constraint on lexical access by trying to replicate their results in another language. Second, the use of eye-tracking offers an excellent insight into the temporal variable of language processing and therefore it is optimal for examining lexical access and its subsequent processes. In addition, reading does not require any overt responses. Thus, the current study may offer valuable insights into the dynamic nature of selectivity in bilingual lexical access (Lauro & Schwartz, 2017), examining the question of if, when, and why non-selective access occurs.

2.1 Experiment

2.1.1 Method

Participants

30 Norwegian-English successive bilinguals (15 female, 15 male) participated in the experiment. At the time of the experiment, the mean age of the participants was 27.5 years ($SD = 3.45$) (see Table 1 for descriptive statistics). The participants were recruited through advertisements in Trondheim, Norway which stated a prerequisite of growing up in Norway with Norwegian as a first language. All were native speakers of Norwegian and as a language history questionnaire (see Appendix A) confirmed, none of them were fluent in any other language but Norwegian or English. Additionally, all the participants began learning English in primary school and were living in a monolingual (Norwegian) community. The mean self-rated knowledge of L2 English was 5.78 ($SD = 1$) on a seven-point Likert scale. All of the participants used *Bokmål* as a written standard, which was also the written standard of the cognate words. The participants received a gift voucher of 100 NOK (9£) for participating in the study.

It is important to notice that the age of acquisition of English differed between the participants, as the youngest participant was 22 years and the oldest was 37 years. According to the national curriculums from 1987 and 1997, pupils starting primary education from 1997 started learning English as a second language from 1st grade (5-6 years) and participants starting their primary education before this started their English teaching from 4th grade (10-11 years) (*Mønsterplan for grunnskolen: M87*, 1987; Veiteberg, 1996). Thus, 16 of our participants started their English education approximately 3 years earlier than the rest. I will return to this point in the data analysis.

Table 1

Overview of the language background of the participants

Measure	<i>M</i>	<i>SD</i>
Age	27.5	(4.02)
Years of education ^a	16.5	(1.92)
Self-rated written understanding (reading) ^b	6.13	(0.93)
Self-rated written production (writing) ^b	5.5	(1.04)
Self-rated oral understanding (listening) ^b	6.13	(0.82)
Self-rated oral production (speaking) ^b	5.36	(0.96)
Total self-rated L2 knowledge	5.78	(1)
LexTALE score ^c	84.07	(13.27)

^aPrimary + higher education^bSeven point Likert-scale (1 = low, 7 = high)^cScore in % (min. = 50%, max. = 100%)**Material**

We constructed 264 sentences out of 132 identical Norwegian-English cognate words and 132 control words. We thus had four groups of sentences and there were two constraint conditions (high vs. low constraint) for each word type (cognate and control) (see Table 2 for examples, full item list in Appendix B). The sentences within the word type condition (cognate vs. control) were as identical as possible and only differed on a maximum of two words, thus making the high constraint and low constraint sentence with the same target words almost identical (see Appendix C for a full list of the sentences). Between the conditions, the cognate and control sentences were matched on the number of words, the word preceding the target word, as well as syntactic structure. This was done to make the data analysis easier, and to avoid any differing gaze patterns due to differences between the sentences.

Table 2

Examples of the sentences in each condition. Target words in bold.

Sentence constraint	Word type	
	Cognate	Control
High	The airplane was flown by a pilot who was experienced.	The doctor was accompanied by a nurse who worked there.
Low	The tour was guided by a pilot who was experienced.	The seller was accompanied by a nurse who worked there.

The cognates and the control words were matched in word length, frequency and word class, and they were not phonologically similar to each other. The mean length for cognate words was 5.75 ($SD = 1.24$) and the mean length for control words was 5.75 ($SD = 1.27$). The frequencies between a cognate and a non-cognate did not differ more than 0.4 on the Zipf frequency scale (1 = low frequency, 7 = high frequency) and the frequencies were calculated using SUBTLEX-UK word frequency database (Van Heuven, Mandera, Keuleers, & Brysbaert, 2014). The mean English Zipf frequency for the cognates was 4.33 ($SD = 0.38$), whereas the mean frequency for the control words was 4.32 ($SD = 0.44$). Mean Norwegian frequency for the cognates was 4.04 ($SD = 0.46$). For cognate words, the difference between the means of the Zipf-frequencies between the two languages was 0.25.

Cloze probability tests

30 participants from the same population as the experiment completed a sentence completion test online to determine the Cloze probabilities, i.e. the probability of a certain word occurring in a given sentence, of the stimulus material. Our Cloze test had 264 sentences in total and was divided into two tests (15 participants per test) to avoid repetition between the high and low constraint sentence pairs, which were almost identical. Each participant was presented with 132 sentences, and asked to complete the sentence with the first word that came to mind. Based on these tests, we excluded 148 sentences because 43 of the high constraint sentences did not reach over 60% probability and 9 of the low constraint sentences were not below 40% probability, resulting in the other sentences in the group having to be excluded as well, since we were comparing four different types of sentences for the main experiment. This

resulted in a total of 118 sentences for the main experiment: 59 cognate and non-cognate pairs in high constraining sentences and 59 cognate and non-cognate pairs in low constraining sentences (see Table 3 for mean Cloze probabilities).

Table 3

Mean Cloze probabilities for the sentence constraints per condition in % (SDs in parentheses)

Sentence constraint	Word type	
	Cognate	Control
High	83.68 (12.4)	83.46 (15.79)
Low	2.79 (5.69)	8 (12.55)

Language tests

In order to obtain an objective measure of the participants' English proficiency, they were asked to complete LexTALE, a 'lexical test for advanced learners of English' (Lemhöfer & Broersma, 2012). The average score for this test was 84.07% (SD = 13.26). In addition, participants were asked to self-rate their qualifications in English in the language history questionnaire, rating their reading and speaking comprehension and production on a Likert-scale from 1 (low) to 7 (high) (see Table 1 for a complete overview of the means). We ran a linear regression analysis on how age and education, including an interaction between age and education, as well as the use of L2 language (daily, weekly or monthly) and extra university level studies can predict L2 knowledge. The analysis showed significant results for the use of English (daily, weekly, monthly) ($p < .001$). These results confirm that the results on the LexTALE test go up with increased use of English in daily life and work. Additionally, although not significant, the analysis revealed that the LexTALE results increase numerically with age, ($p = .566$). This indicates that the differing age of acquisition is not necessarily a confound in this study, as the older participants, who had received less education in English when in primary school, were not less proficient in their L2 English.

Apparatus

We used an SR EyeLink 1000 eyetracker to record the eye movements of the participants during the experiment. We recorded the binocular eye movements of the participants and gaze locations were recorded every millisecond. The stimulus sentences were

no longer than 80 characters, and presented on one line as black text (14 pt. Times New Roman) on a white background. There was always at least one word after the target word and at least four words before the target word.

Procedure

The experiments were conducted at the Language Acquisition and Language Processing Lab at the Norwegian University of Science and Technology in Trondheim, Norway. Participants were told that the study investigates how Norwegian speakers read English text. Instructions were presented on the screen in English. We asked the participants to read the sentences naturally, as if they were reading a newspaper, and to press a button when they had read the sentence. A new sentence would then appear and the experiment would proceed this way until the participant had finished reading all the sentences. The whole experiment, along with calibration (standard 9-point grid), and filling out the language test and form would take approximately 30 minutes.

Design

In order to avoid repetition priming (Forbach, Stanners, & Hochhaus, 1974; Kirsner & Smith, 1974) each participant would only see one of the sentences in the word type condition, so that none of the nearly identical sentences would be repeated and no target word would be seen twice. The participants therefore saw one of four possible combinations (randomly assigned): H (High constraining) control and L (Low constraining) cognate, or H cognate and L control, or H cognate and H control, or L cognate and L control. The sentences were presented in random order and each participant read a total of 59 sentences.

2.1.2 Data analysis

Following van Assche et al. (2011), we included both early and late eye-movement measures (Clifton, Staub, & Rayner, 2007) in our analysis. We defined the interest area for the target as including the space before, but not after the target word. For early eye tracking measures, we analysed gaze duration, first fixation duration and the number of skipped targets. Gaze duration is the summation of the duration of all fixations of the first time within the area of the target word, whereas first fixation duration is the duration of the first fixation within the target area (SR Research Ltd., 2002-2008). We also included the percentage of first pass regressions from the interest area, i.e. how many times regressions were made out from the interest area to previous parts of the sentence. In order to analyse later eye tracking measures, we included go-past time and total reading time in the analysis. GPT is the summation of all fixations on the target word occurring before passing on to a word to the right of the target (van

Assche et al., 2011); total time is the sum of the duration of all fixations in the area of the target (SR Research Ltd., 2002-2008). The late measures are thought to be an indication of semantic integration, whereas the early measures are assumed to be an indication of word identification processes and lexical access (van Assche et al., 2011). Lastly, since the processing times can “spillover” to the upcoming word (Rayner & Duffy, 1986; Rayner, Sereno, Morris, Schmauder, & Clifton, 1989), we included the duration of the first fixation made on the next word after the target, called the spillover region. The spillover region was defined as a fixed width interest area, such that it would include two words if the following word was short, but only one word if the following word was more than four characters.

For the data analysis, we used linear mixed-effects models in the *Lme4* package (Bates, Mächler, Bolker, & Walker, 2015) in the R environment (R Core Team, 2016). Before analysing the data, target words that were skipped by the participants (15.7% in total) were coded as missing values for gaze duration, first fixation duration, dwell time, go past time and for first pass regressions. For all the models, we included random intercepts for participants and items to control for random effects based on participants and target words. Additionally, we included a correlation between intercept and sentence constraint per target word in the models (except for dwell time and skipped targets, as these models failed to converge). Although the interaction between sentence constraint and word type was not significant for any of the eye tracking measures, we kept it in the models because it is sensible due to the experimental design: we were manipulating the interaction between these two variables. These models were run with sentence constraint, word type and frequency as predictors. To further investigate the effect of sentence constraint, we also ran separate analyses on the eye tracking measures for only the high constraining sentences, with word type as a predictor and random intercepts for participants and items. We ran a logistic model for the skipped words variable, as this variable was binomial. Below, we first report the results of the first-pass measures followed by the results on the later stage eye movement measures, after which we discuss the results in the same order in the General Discussion.

2.1.3 Results

First-pass eye-tracking measures

Skipped targets. As was expected, the percentage of skipped targets in the high constraining sentences was higher than in the low constraining sentences (see Table 4 for percentages). In the low constraint, cognates were skipped more often than controls. In contrast, the percentages were similar for both types of target words in high constraining sentences. An

analysis revealed that readers skipped high constraint words more often than low constraint words [$z = -2.567, p = .010$]. There was no effect of word type [$z = -1.504, p = .133$] and no interaction between word type and sentence constraint [$z = 1.584, p = .113$]. The effect of frequency was not significant in this model [$z = 0.865, p = .387$]. The analysis for the high constraint data did not reveal any effect of word type on whether targets were skipped or not [$z = -1.243, p = .214$].

Table 4

Percentages of skipped target words

Sentence constraint	Word type		
	Total	Cognate	Control
High	18.4 %	17.6 %	19.3 %
Low	12.7 %	14.7 %	10.7 %

Gaze duration. Importantly, the effect of sentence constraint on gaze duration was significant [$|t| = 2.099$], with target words in low constraint sentences having significantly longer gaze durations than targets in high constraining sentences (see Fig. 1). A second significant result was that cognates had significantly shorter gaze durations compared to controls [$|t| = 2.324$], which is reflected in the plots in Fig. 1. For gaze duration, the interaction between word type and sentence constraint [$|t| = 1.096$] was not significant. The same applied for frequency [$|t| = 0.112$]. The analysis on only the high constraining sentences further showed a significant effect of word type: cognates had significantly shorter gaze durations than controls [$|t| = 2.002$].

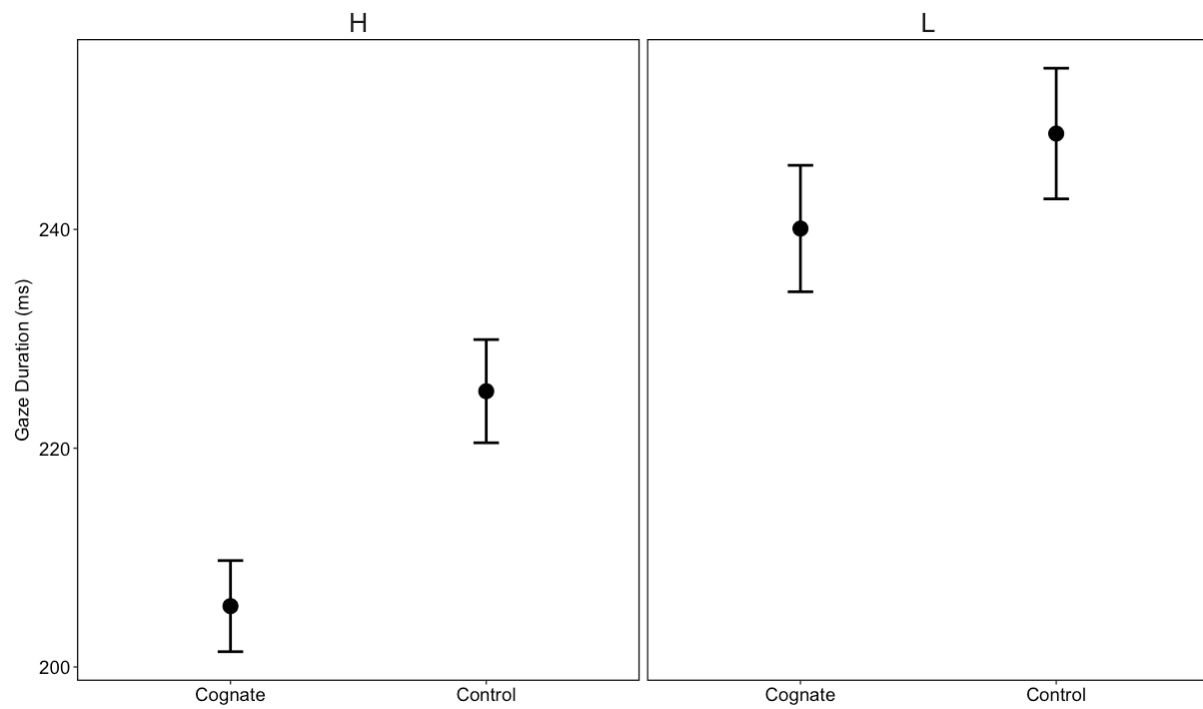


Fig. 1 Mean gaze durations (in milliseconds) by word type for high constraints (left) and low constraints (right). Error bars represent the standard error of the mean.

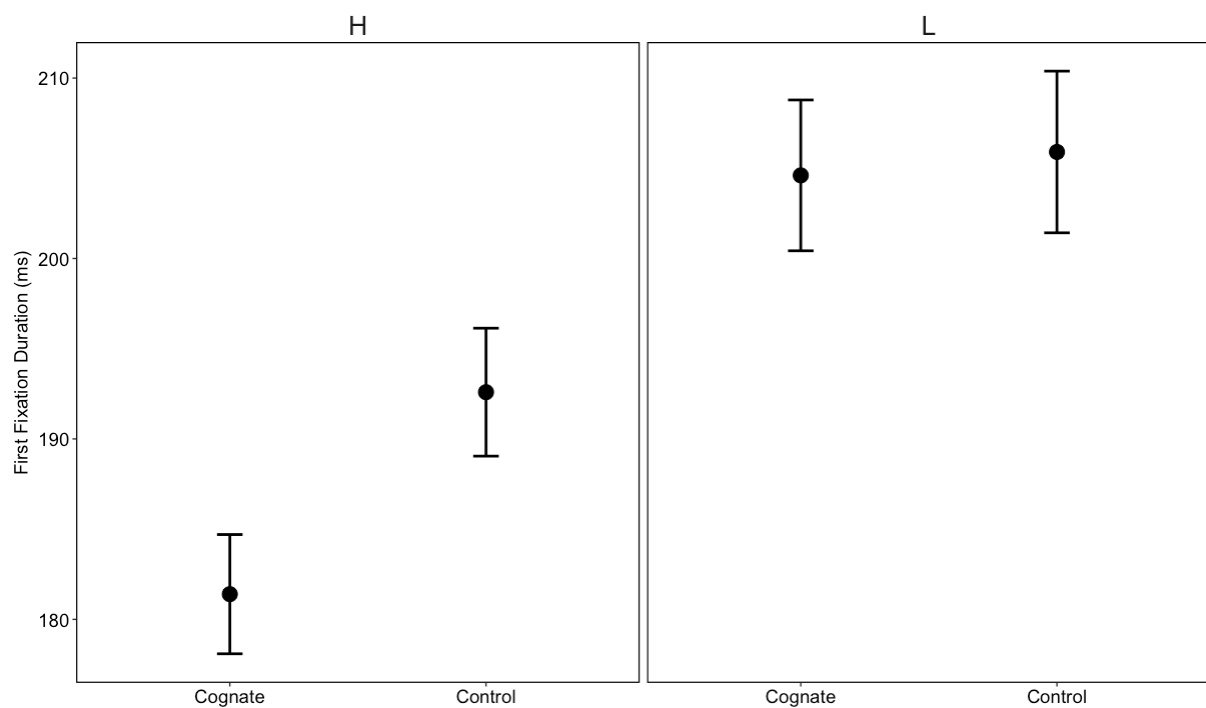


Fig. 2 Mean first fixation durations (in milliseconds) by word type for high constraints (left) and low constraints (right). Error bars represent the standard error of the mean.

First fixation duration. Frequency had a significant effect on the first fixation durations [$|t| = 2.207$], with more frequent words receiving shorter fixation times. For this measure, word type [$|t| = 1.019$] and sentence constraint [$|t| = 0.845$] was not significant and neither was the interaction between these two variables [$|t| = 0.065$]. As can be seen from the plots in Fig. 2, cognates in high constraining sentences had numerically shorter first fixation durations than controls, although this was not significant. However, word type was not significant for first fixation durations in the high constraint analysis either [$|t| = 1.778$].

Spillover region We analysed whether there are any significant differences in the duration of the first fixation made on the region after the target word (spillover region). We did not find any significant results regarding word type [$|t| = 0.524$], sentence constraint [$|t| = 0.464$], their interaction [$|t| = 0.508$] or frequency [$|t| = 0.192$]. Control words had numerically shorter first fixations in the spillover region compared to cognates, as can be seen from in Fig. 3. The durations for spillover regions was not affected by word type in the high constraining sentences either [$|t| = 0.432$].

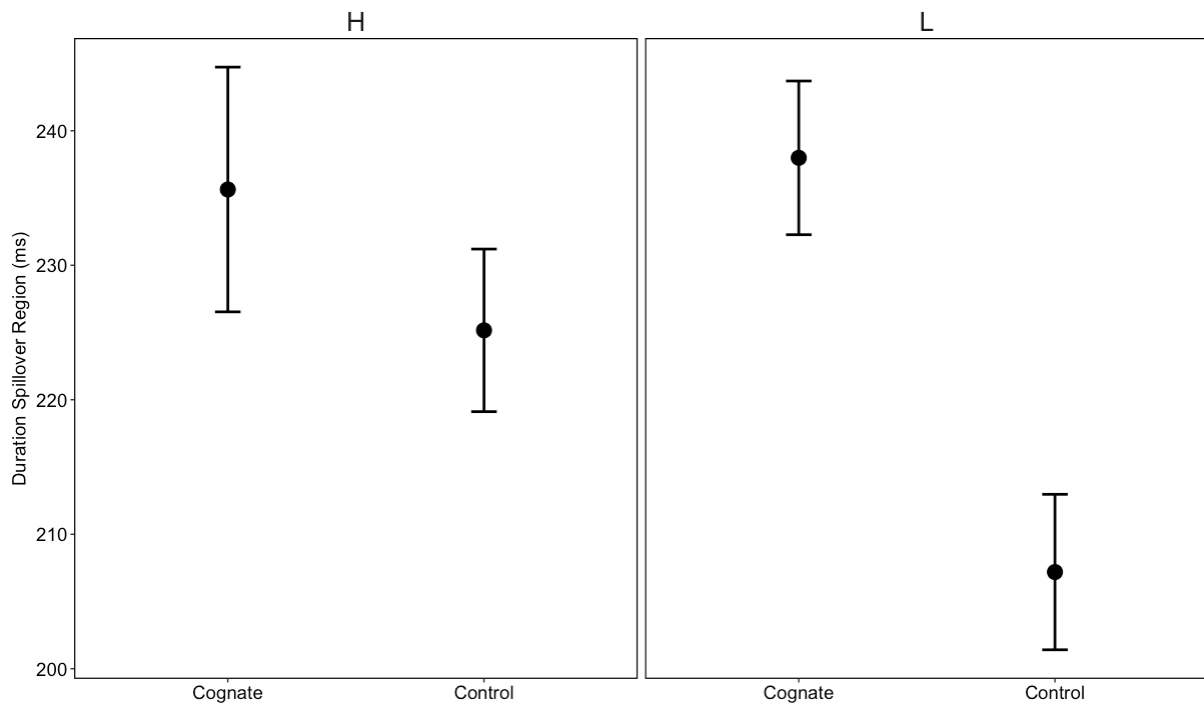


Fig. 3 Mean durations for the spillover region (in milliseconds) by word type for high constraints (left) and low constraints (right). Error bars represent the standard error of the mean.

Regressions. Lastly, there were no large differences between the four conditions on whether regressions were made out from the target area to an earlier part of the sentence, in the

first-pass run. As can be seen in Table 5, the percentages between all four conditions are similar. Therefore, we did not go further with any analyses on this measure.

Table 5

Percentages of regressions made out from the region of the target words

Sentence constraint	Word type	
	Cognate	Control
High	21.2 %	21.6 %
Low	20.3 %	19.3 %

Late eye-tracking measures

Go past time. For the go past time measure, the model reported no significant results for word type [$|t| = 0.551$], sentence constraint [$|t| = 0.931$], the interaction between word type and sentence constraint [$|t| = 0.580$] or frequency [$|t| = 0.319$]. These results are confirmed by looking at the plots in Fig. 4, indicating that the means of the go past times do not differ between the word types within each constraint condition. The same result was obtained in the high constraint analysis: the effect of word type was not significant [$|t| = 0.098$].

Total time. For total time, the analysis revealed no significant results for word type [$|t| = 0.978$], the interaction between word type and sentence constraint [$|t| = 0.590$] or frequency [$|t| = 0.285$]. The effect of sentence constraint was not found significant either [$|t| = 1.945$] but the values for total time were numerically larger for the target area for sentences with a low constraining sentence and for non-cognate target words. This can also be appreciated by looking at the plots in Fig. 5, where the mean total times for targets in high constraining sentences are higher than the low constraint sentences. The high constraint analysis revealed that the effect of word type was not significant here either [$|t| = 0.566$].

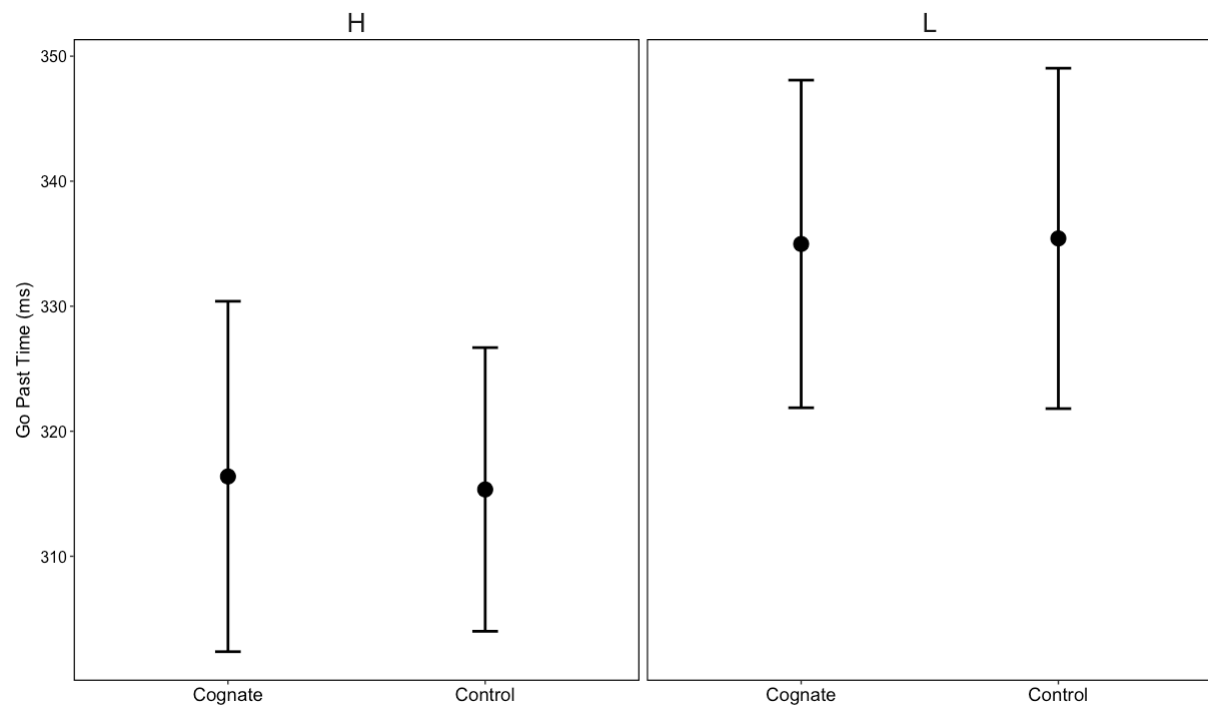


Fig. 4 Mean go past times (in milliseconds) by word type for high constraints (left) and low constraints (right). Error bars represent the standard error of the mean.

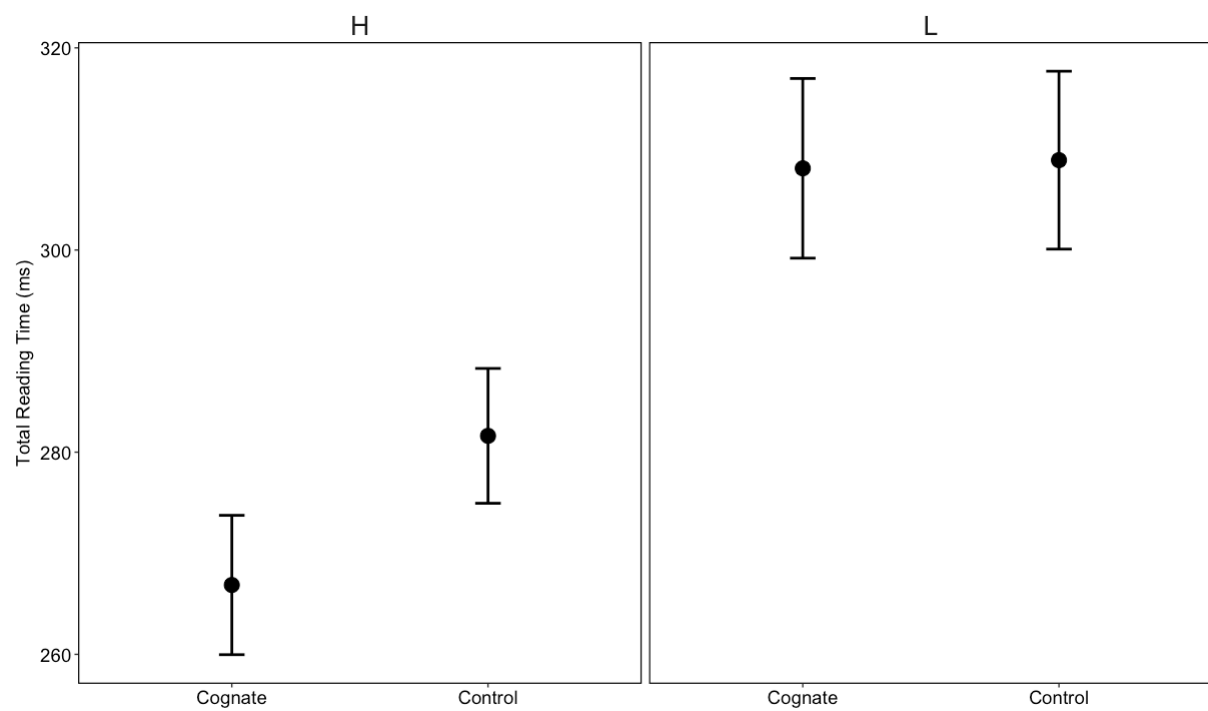


Fig. 5 Mean total reading time (in milliseconds) by word type for high constraints (left) and low constraints (right). Error bars represent the standard error of the mean.

3 General Discussion

The main goal of this study was to examine whether sentence context can constrain non-selective language activation by looking at the cognate facilitation effect as a measure of this activation, and further whether bilingual lexical access is dynamic in its selectivity. The present study shows that word type has a significant effect on gaze durations, with cognates receiving shorter gaze durations than their control words. This is consistent with the cognate facilitation effect found in earlier studies (Dijkstra et al., 2015; Duyck et al., 2007; van Assche et al., 2011; van Assche et al., 2009; van Hell & de Groot, 2008), indicating that the processes of lexical access in bilinguals may be nonselective. Although not significant, our data analysis showed that for first fixation durations, total time and go past time, the durations were numerically shorter for cognates. This indicates that the measures for these variables do not disprove the hypothesis of cognates being processed faster than non-cognates.

The effect of sentence constraint turned out to be significant for gaze durations and skipping rates. Target words in low constraining sentence contexts received longer gaze durations than the corresponding words in a high constraining context and were skipped less often. The same pattern was seen in the non-significant numbers for first fixation duration and total time. This is what we would expect based on what we know about the effect of sentence constraint from previous studies (Ehrlich & Rayner, 1981; Rayner & Well, 1996; Schwanenflugel & Shoben, 1985): A high constraining sentence context eases the processing of targets. However, as the interaction between sentence constraint and word type was not significant for gaze durations (nor any other eye tracking measure), it is difficult to conclude how these two variables affect reading times and fixations altogether.

Crucially, the analysis based on only the data for high constraining sentences revealed that word type was significant for gaze durations. This is convergent with the findings of Libben and Titone (2009), who also found an effect of word type in high constraint sentences, but only in the early reading measures. Thus, our data suggests that high constraining sentences do not inhibit the cognate facilitation effect. On the contrary, by looking at the plots for means of the gaze durations (Fig. 1), first fixation durations (Fig. 2) and total time (Fig. 5), the means for word type are lower for cognates than controls in high constraint sentences, whereas the means for word type in low constraint sentences are almost the same. Although it is not statistically significant, the data looks as if the high constraint sentences actually boosted the cognate facilitation effect. This is not consistent with the conclusion of Lauro and Schwartz (2017), who found that the weighted effect size of the cognate facilitation effect in both high and low

constraining sentences was significant, but that the effect is smaller in high constraining contexts. A crucial follow-up study would therefore be to conduct the experiment with English monolinguals.

The results in our study replicate some of the results of van Assche et al. (2011): shorter gaze durations on cognates, shorter gaze durations in high sentence constraints, more skipped targets in a high constraining sentence context and shorter first fixation durations on more frequent words. Our results differ from theirs by the other first pass measures, where sentence constraint and word type was not found significant in our study as opposed to their study. They also found that cognates were skipped more often than controls. For the late eye tracking measures, we did not find significant effects for any of the predictors, whereas van Assche et al. (2011) found a cognate facilitation effect also for the go past time. The reason for this might be the different cognitive processes the early and late measures are thought to reflect. The early measures are thought to 'reflect processes that occur early in the initial stages of sentence processing' (Clifton et al., 2007, p. 349), and one of these initial stages would be lexical access (Onifer & Swinney, 1981; Seidenberg, Tanenhaus, Leiman, & Bienkowski, 1982). Thus, the fact that we did not obtain any results for the later stage measures does not refute the hypothesis of non-selective activation in the bilingual lexicon, which is thought to happen at least during lexical access.

Word type was not significant for the percentage of skipped targets, which can be interpreted considering the effect of sentence constraint. Since sentence constraint was significant for whether a target word was skipped or not, but did not differ between the two types of words, this suggests that the semantical context of a sentence overrides the cognate facilitation effect when it comes to the probability of skipping targets. In other words, having a high constraining sentence context would make it more likely for a target to be skipped, regardless of its status between two languages. This finding can be interpreted in context of Rayner and Well (1996), who proposed that while fixation times reflect word comprehension processes, target word skipping rates might be affected by lower level visual features, such as the length of the following word. This might be a reason for why we did not find an effect of word type for this measure.

Why was sentence constraint and word type found significant only for some of the early pass measures, and none of the later stage measures? One reason for this might be that we did not include the effect of phonological similarity in our selection and rating of stimuli. Previous studies have shown that phonological, orthographic and semantic overlap between the cognates in the two languages yield different results in their processing times. For instance, Dijkstra et

al. (1999) found that for bilinguals, increased phonological overlap between words in two languages lead to inhibitory effects in processing, whereas semantic and orthographic overlap led to facilitation. Our study took the latter in consideration when designing the stimuli by choosing only orthographically identical cognates. Therefore, in line with the study of Dijkstra et al. (1999), we should have found facilitation in our analysis. Since we did not find this facilitation effect for other than one eye tracking measure, a follow-up study to do would be to include phonological similarity ratings of the stimulus words, to see whether a possible phonological overlap could have led to the different results between our study and van Assche et al. (2011). Another issue related to phonological overlap is the great variation of dialects in Norway. The language history questionnaire revealed that there were participants from five major dialect groups in Norway. This means that there may be a large variation in phonological representations between the participants, which might have affected our results.

We also found that frequency had a significant effect on first fixation durations, but not any of the other early eye tracking measures. We know from earlier studies that more frequent words receive shorter fixation times (Inhoff & Rayner, 1986; Rayner & Duffy, 1986). However, it is surprising that we did not obtain this result for the other measures, especially gaze duration, which is more sensitive for the effect of word frequency (Inhoff & Rayner, 1986). The reason why we did not achieve an effect of frequency for any of the other measures might be because the frequencies of our target words were quite similar to each other and none of the frequencies were extremely high or low (minimum Zipf frequency was 3.4 and the maximum frequency was 5.2, $M = 4.33$ ($SD = 0.33$)). Therefore, our target words did not have sufficient variation in the word frequencies to obtain any conclusive results on how or whether frequency modulates the cognate effect or sentence constraint effect.

The BIA+ model

The results from our study suggest that bilingual lexical access is non-selective in nature, and the earlier research suggests that the selectivity can be attenuated by sentence constraint. Here, we discuss the results of the present study and the earlier studies in context of the BIA+ model by Dijkstra and van Heuven (2002).

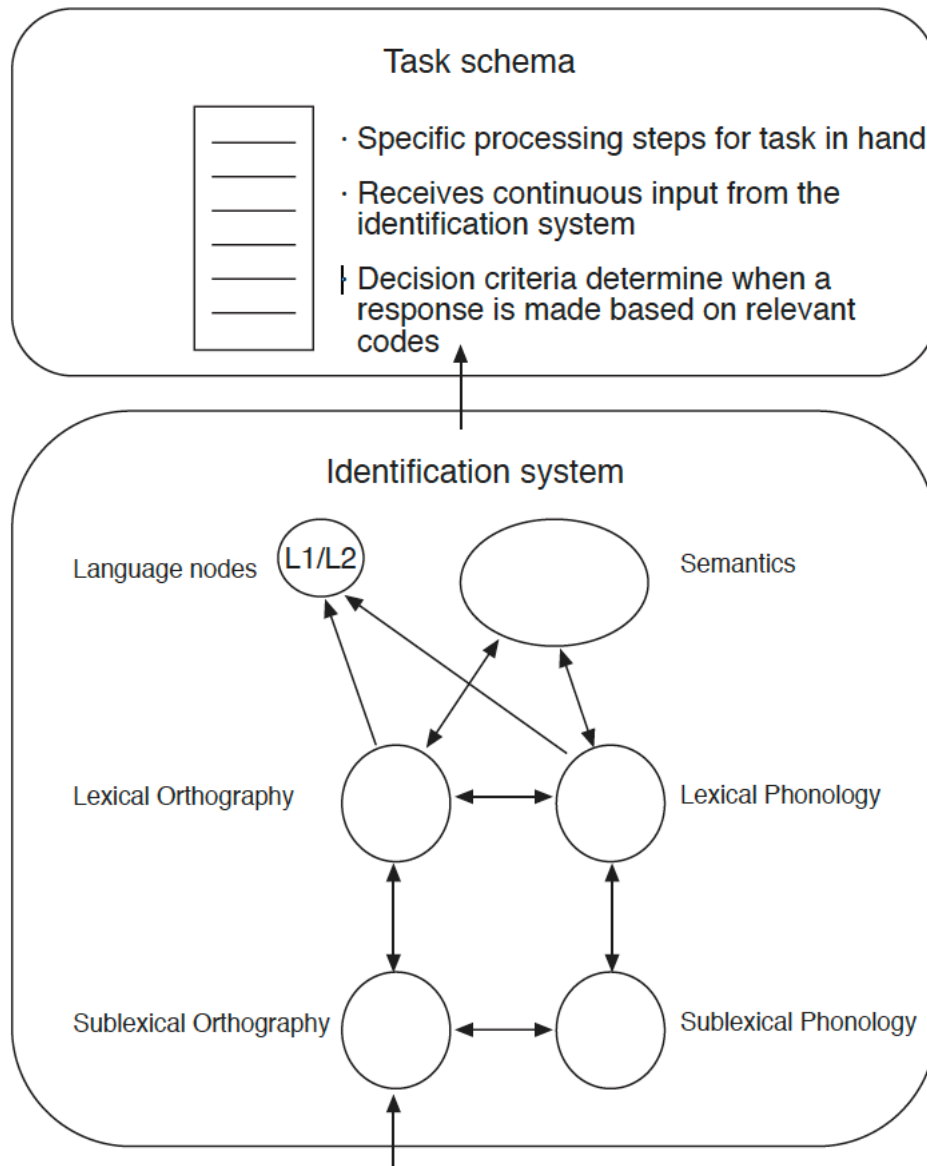


Fig. 6 The BIA+ model (Dijkstra & van Heuven, 2002)

The BIA+ (Bilingual Interactive Activation plus) model (Dijkstra & van Heuven, 2002) (see Fig. 6) is an extension of the BIA model of van Heuven, Dijkstra, and Grainger (1998). The BIA+ assumes that lexical representations in the bilingual mental lexicon exist in one integrated lexicon, and that the activation of words (lexical access) initially happens in a non-selective and parallel manner (Dijkstra & van Heuven, 2002; van Heuven et al., 1998). In contrast to its predecessor, ‘bilingual word recognition is affected not only by cross-linguistic orthographic similarity effects, but also by cross-linguistic phonological and semantic overlap’ (Dijkstra & van Heuven, 2002, p. 182). In the model, language membership is represented by language nodes, which cannot directly affect language selection in the initial stages of lexical

access. The model distinguishes between a task/decision system and a word identification system. The latter is not affected by extra-linguistic factors, such as task demands, which is why we find non-selectivity in the activation process.

As is the assumption in the Interactive Activation (IA) model (McClelland & Rumelhart, 1981), several ‘lexical orthographic candidates’ are activated in parallel when a string is presented to the model and the level of activation depends on the number of candidates orthographically similar to the presented string (Dijkstra & van Heuven, 2002). Based on empirical evidence (Dijkstra et al., 1999; Lemhöfer & Dijkstra, 2004; van Hell & Dijkstra, 2002), the representation of cognates in the BIA+ model is thought to be special, with a possible ‘strong feedback connection from semantics to orthography’ (Dijkstra & van Heuven, 2002, p. 184) and two ‘possibly partially overlapping’ representations. As an example, the cognate word *hammer* would lead to a bottom-up activation from the orthographic layer, which spreads to the shared semantic representation of the cognate in both languages (see Fig. 7) (Dijkstra, Miwa, Brummelhuis, Sappelli, & Baayen, 2010). This is supported by evidence from for instance a generalized lexical decision task, where Dutch-English bilinguals were presented with interlingual homographs (form overlap, but no semantic overlap) and cognates (Lemhöfer & Dijkstra, 2004). The RTs for cognates were facilitated relative to their controls, whereas interlingual homographs were not. The BIA+ assumes that it is the shared semantical component between the two languages that speeds up the recognition for cognates.

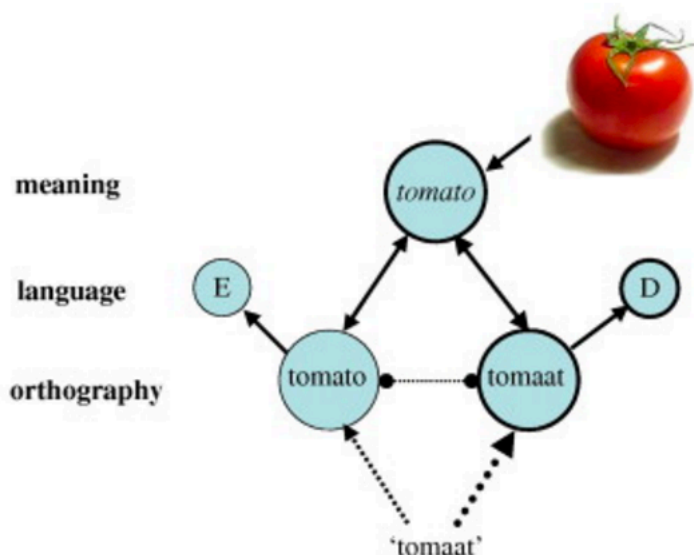


Fig. 7 Graphical illustration of cognate representations in the bilingual lexicon (Dijkstra et al., 2010)

The BIA+ assumes that lexical, syntactic and semantic information from the sentence can affect word recognition and therefore a sentence context can constrain ‘the degree of language selective access’ in the lexicon (Dijkstra & van Heuven, 2002, p. 187). As is consistent with our results, and the results of other studies (Lauro & Schwartz, 2017; Libben & Titone, 2009), non-selective access happens in a dynamic fashion and fluctuates between initial non-selectivity and selective access in the BIA+. Contextual factors, such as sentence constraint, may serve as constraining factors, biasing the dynamic process of language selection towards selective access. However, explaining the role of semantical context is a shortcoming of the BIA+, because it does not clearly account for how a high constraining context is sometimes able to eliminate a cognate effect, and further how the effect can persist in a low constraining sentence. Thus, there must be something in the strong semantic cues of a high constraint which leads to a faster activation of the language nodes. In Schwanenflugel and Shoben (1985), the assumption was that a high constraining sentence leads to the activation of more (correct) semantic nodes (than a low constraining sentence), which in turn facilitates compatible word nodes and inhibits related competing word nodes. Considering this, a possible explanation of the high constraint effect on cognate facilitation is that the constraint leads to an earlier top-down activation of the semantic layer, which in turn results in an earlier activation of the language nodes. Since the high constraint already has activated the semantic nodes, the effect of the shared semantics of a cognate would not have such a strong effect on the activation process. On the other hand, this does not explain why some studies, including ours, did not find an elimination in the high constraint.

By interpreting the data from this perspective, one can explain the differing findings regarding the effect of sentence constraint, which we discussed in the introduction. Since many studies only found a partial elimination in high constraint sentences, and only a few found a complete elimination (Schwartz & Kroll, 2006; van Hell & de Groot, 2008), it is likely that the differing results are due to experimental differences between the studies, such as the task employed or the language of the task (Lauro & Schwartz, 2017). As our study used eye-tracking, which is excellent for studying the temporal variable of word processing, we conclude that bilingual word recognition is non-selective in the early stages of processing, even in a strong semantical context. However, in some situations, this non-selectivity can be biased towards selectivity by semantical sentence context. More research is needed to examine the exact causes and underlying mechanisms of this bias.

4 Conclusion

The main object of the study was to investigate the effect of a high constraining sentence context on cognate facilitation. Firstly, our results support the cognate facilitation effect, as these effects were observed for gaze duration, which is an early eye-tracking measure. We did not find any significant results for the effect of word type in the late measures. Our data supports the hypothesis of initial nonselective lexical access in bilinguals. Second, our study further confirmed the effect of sentence constraint on word processing, where a high constraining context leads to faster processing times. This confirms that the manipulation of constraint was effective, at least for gaze durations. Thirdly, and most importantly, we found that a high constraint did not eliminate the cognate facilitation effect. The results are in contrast with the studies finding elimination or inhibition of the cognate effect in high constraints. We see this as support for a dynamic non-selectivity in bilingual lexical access, because we found evidence of facilitation for cognates also in high constraining sentences. However, although a dynamic selectivity can account for the different results of the effect of sentence constraint on cognates, little is known about exactly what has led to the differing results in the literature. It is thus necessary to further account for the role of constraint in research and in theoretical models, such as the BIA+ model.

To further investigate and interpret our results, it would be interesting to compare the results from bilingual participants to a group of monolingual English native speakers. This might shed light on possible confounds and other factors which could have affected our results, especially the reason why we only found effects of word type for gaze durations, and none of the other reading measures, and also why the means in low constraint sentences seemed to be almost the same for gaze duration, first fixation duration and total time. Our study adds to the existing literature in two ways: (1) by using eye-tracking, we have a more precise measure of the time course of word processing and lexical access, and (2) by using identical cognates, we can eliminate any effects of orthographic overlap. For future research, it would be interesting to examine the effect of phonological overlap on cognate processing in sentence constraints, and further to perform the same experiment with the stimulus material being in the participants' L1 language.

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Appendix A

Language History Questionnaire

Age _____

Gender Female ☐ Male ☐

Occupation _____

Education

Secondary School Qualifying for Higher Education	<input type="checkbox"/>
Secondary School Vocational	<input type="checkbox"/>
Bachelor's Degree	<input type="checkbox"/>
Master's Degree	<input type="checkbox"/>
PhD	<input type="checkbox"/>

Are you born and raised in Norway?

Born ☐

Raised ☐

Both ☐

Do you speak other languages than Norwegian and English fluently?

Yes ☐

No ☐

If yes, which language(s)? _____

Have you ever studied another language than Norwegian or English (e.g. German in school)?

Yes ☐

No ☐

Does either of your parents speak any language(s) other than Norwegian and English fluently?

(continued on next page)

Yes ☐

No ☐

Have you lived abroad for more than a year?

Yes ☐

No ☐

If yes, where and how long? _____

Have you taken extra courses in English, such as a EF Programme or a study year abroad?

Yes ☐

No ☐

Do you use Bokmål or Nynorsk when you write (usually)?

Bokmål ☐

Nynorsk ☐

Both ☐

Do you often use dialect when you write Norwegian or do you only use the formal language?

Dialect and formal language ☐

Only formal language ☐

Which dialect do you speak? _____

How often do you use English (written or oral)?

Daily ☐

Weekly ☐

Monthly ☐

Less ☐

(continued on next page)

Do you use English regularly at work or in your studies?

Yes ☐

No ☐

Do you have or did you have subjects instructed only in English during your studies?

Yes ☐

No ☐

On a scale from 1 to 7 (low to high), please rate your ability in

Written English comprehension (reading)

Written English production (writing)

Spoken English comprehension (listening)

Spoken English production (speaking)

Appendix B

Item list with phonological transcriptions of cognates

Cognate word	Phonological transcription (Am. English)	Phonological transcription (Norwegian)	Control word
agent	[ˈeɪdʒənt]	[aˈgənt]	actor
album	[ˈælbəm]	[alˈbəm]	plate
astronaut	[ˈæstrəˌnaʊt]	[astruˈnæʊt]	fairytale
bank	[bæŋk]	[baŋk]	shop
diabetes	[ˌdaɪəˈbitɪz]	[diaˈbe:təs]	headache
festival	[ˈfɛstɪvəl]	[fɛstiˈva:l]	mountain
frost	[frɒst]	[frɒst]	tooth
golf	[gɒlf]	[gɒlf]	fuel
grill	[grɪl]	[gril:]	stove
hammer	[ˈhæməɹ]	[ˈhamər]	cheese
juice	[dʒʊs]	[iʊs]	honey
magnet	[ˈmæɡnət]	[maŋˈne:t]	pillow
opera	[ˈopərə]	[uˈprə]	jokes
parade	[pəˈreɪd]	[paˈradə]	trophy
pasta	[ˈpastə]	[ˈpasta]	snake
pepper	[ˈpɛpər]	[ˈpepər]	salmon
piano	[piˈænoʊ]	[piˈɑ:nu]	drums
pilot	[ˈpaɪlət]	[piˈlu:t]	nurse
planet	[ˈplænət]	[praˈne:t]	prison
religion	[rɪˈlɪdʒən]	[rəliˈgiu:n]	currency
safari	[səˈfəri]	[saˈfa:ri]	refund
signal	[ˈsɪɡnəl]	[sɪŋˈna:l]	ticket
sport	[spɔrt]	[spuʔ]	birds
storm	[stɔrm]	[stɔrm]	movie
stress	[strɛs]	[strəs]	dishes
studio	[ˈstʊdiˌoʊ]	[ˈstʊdiu]	prison
tennis	[ˈtɛnəs]	[ˈtenis]	horses
uniform	[ˈjunəˌfɔrm]	[ʏniˈfɔrm]	license
vase	[veɪs]	[va:sə]	pond

Appendix C

Sentence contexts with target words marked in bold

High-constraint/cognate

1. James Bond is an **agent** in the secret service.
 2. Her mother put all the photos in an **album** for her.
 3. Neil Armstrong is a very famous **astronaut** from the US.
 4. He needed to cash the cheque, so he went to the **bank** downtown.
 5. People who take insulin suffer from **diabetes**, a chronic disease.
 6. Coachella is the most famous **festival** in the world.
 7. Simon took the anti-freeze to remove the **frost** on his car.
 8. Tiger Woods plays much more **golf** than anyone.
 9. The meat was sizzling on the **grill** at the BBQ.
 10. To hang the painting, David brought some nails and a **hammer** with him.
 11. When you squeeze the oranges yourself, the **juice** tastes much better.
 12. On his fridge, he had a **magnet** and a post card.
 13. Pavarotti is very famous for singing **opera** everywhere.
 14. On the National day, there is a big **parade** on Karl Johan's street.
 15. Spaghetti is a type of **pasta** with sauce.
 16. The most common black spice here is **pepper** from India.
 17. Stevie Wonder is remarkable at playing the **piano** anywhere.
 18. The airplane was flown by a **pilot** who was experienced.
 19. Pluto is not a **planet** anymore.
 20. Buddhism is a very famous **religion** from the East.
 21. He loved to see lions so he went to Africa for a **safari** last month.
 22. She tried to call him from the mountain, but couldn't get a **signal** for her phone.
 23. He said that soccer was his favourite **sport** earlier.
 24. The boat had to return to shore because of a big **storm** yesterday.
 25. During the exam period, she experienced a lot of **stress** all the time.
 26. He recorded the pop song in the **studio** down the road.
 27. Serena Williams is good at **tennis** and running.
 28. Because of strict dress codes, pupils in England have to wear a **uniform** to school.
 29. She put the beautiful flowers in a **vase** and watered them.
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Appendix C *(continued)*

High-constraint/control

1. Brad Pitt is an **actor** in America.
 2. The chef put all the food on a **plate** for her.
 3. Snow White is a very famous **fairytale** from Germany.
 4. He needed to buy some food, so he went to the **shop** yesterday.
 5. People with migraine may suffer from **headache** which is painful.
 6. Kilimanjaro is a very famous **mountain** in Africa.
 7. Carl visited the dentist to extract the **tooth** that bothered him.
 8. An airplane uses much more **fuel** than a car.
 9. The food was cooking on the **stove** in the kitchen.
 10. To celebrate her friend, Anna brought some wine and **cheese** with her.
 11. If you have your own bees, the **honey** is really tasty.
 12. In his bed, he had a **pillow** and a blanket.
 13. Comedians are usually known for telling **jokes** all the time.
 14. In the Cup Final, Chelsea won a big **trophy** at the stadium.
 15. The cobra is a type of **snake** from Asia.
 16. The most common sushi fish here is **salmon** from Norway.
 17. Ringo Starr is remarkable at playing the **drums** anywhere.
 18. The doctor was accompanied by a **nurse** who worked there.
 19. Alcatraz is not a **prison** anymore.
 20. The Euro was a strong **currency** in Europe.
 21. The item was faulty so he went to the shop for a **refund** last month.
 22. She wanted to attend the concert in town, but didn't get a **ticket** anymore.
 23. She wrote that pigeons were her favourite **birds** in the letter.
 24. The cinema had a big ticket sale because of a new **movie** yesterday.
 25. When cleaning the kitchen, she washed a lot of **dishes** every day.
 26. He served the life sentence in the **prison** on the island.
 27. Jockeys are very fond of **horses** and riding.
 28. In order to drive safely, car drivers always have to have a **license** to drive.
 29. She saw the swimming ducklings in a **pond** and fed them.
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Appendix C *(continued)*

High-constraint/cognate

1. James Jones is an **agent** with the company.
 2. Her mother put all the money in an **album** for her.
 3. Scott Kelly is a very famous **astronaut** from the U.S.
 4. He needed to see his fiancée, so he went to the **bank** downtown.
 5. People who look ill may suffer from **diabetes**, a chronic disease.
 6. This is the most famous **festival** in the world.
 7. Simon got his camera to photograph the **frost** on his car.
 8. David Cooper plays much more **golf** than anyone.
 9. The food was lying on the **grill** at the party.
 10. To fix the apartment, David brought some paint and a **hammer** with him.
 11. When you crush the ice yourself, the **juice** tastes much better.
 12. In his pocket, he had a **magnet** and a pen.
 13. Charlotte is very famous for singing **opera** everywhere.
 14. Every morning and night, there is a big **parade** at the mall.
 15. The product is a type of **pasta** with sauce.
 16. The most commonly bought item here is **pepper** from India.
 17. Steven Brooke is remarkable at assembling the **piano** anywhere.
 18. The tour was guided by a **pilot** who was experienced.
 19. This is not a **planet** anymore.
 20. This is a very famous **religion** from the East.
 21. He loved to travel everywhere so he went to India for a **safari** last month.
 22. She wanted to tell her mother the news, but couldn't get a **signal** on the bus.
 23. He said that this was his favourite **sport** earlier.
 24. The boy had to call his mother because of a big **storm** yesterday.
 25. During the entire vacation, she experienced a lot of **stress** all the time.
 26. He devoured the tasty hamburger in the **studio** down the road.
 27. Catherine Jackson is good at **tennis** and running.
 28. Because of the new rules, workers in England have to wear a **uniform** at work.
 29. She put the beautiful shells in a **vase** and watered them.
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Appendix C *(continued)*

Low-constraint/control

1. Brad Gray is an **actor** in America.
 2. The girl put all the jewellery on a **plate** for her.
 3. The book is a very famous **fairytale** from Germany.
 4. He needed to see his fiancée, so he went to the **shop** yesterday.
 5. People with cancer may suffer from **headache** which is painful.
 6. This is a very famous **mountain** in Africa.
 7. Carl visited the office to remove the **tooth** that bothered him.
 8. This one uses much more **fuel** than that one.
 9. The food was lying on the **stove** in the kitchen.
 10. To celebrate the day, Anna brought some beer and **cheese** with her.
 11. If you have your own supply, the **honey** is really tasty.
 12. In his car, he had a **pillow** and some water.
 13. Authors are usually known for telling **jokes** all the time.
 14. On the final day, she won a big **trophy** at the mall.
 15. The animal is a kind of **snake** from Asia.
 16. The most commonly bought item here is **salmon** from Norway.
 17. Steven Brooke is remarkable at assembling the **drums** anywhere.
 18. The seller was accompanied by a **nurse** who worked there.
 19. This is not a **prison** anymore.
 20. The mark was a very strong **currency** in Europe.
 21. The banana was rotten so he went to the shop for a **refund** last month.
 22. She wanted to join her friends in town, but didn't get a **ticket** anymore.
 23. She wrote that these were her favourite **birds** in the letter.
 24. The company had a big cocktail party because of a new **movie** yesterday.
 25. When cleaning the house, she washed a lot of **dishes** every day.
 26. He visited his good friend in the **prison** on the island.
 27. Farmers are very fond of **horses** and cows.
 28. In order to travel safely, young people always have to have a **license** to go.
 29. She saw the beautiful animals in a **pond** and fed them.
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